NAVAL POSTGRADUATE SCHOOL
Monterey, California

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THESIS

> EXCELLENCE IN FLEET COMBAT REPLACEMENT
> SQUADRONS: PREDICTING CARRIER
> QUALIFICATION SUCCESS
>
> by
>
> Martin P. Smith
>
> March 1988
>
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REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION	1b RESTRICTIVE MARKINGS
UNCLASSIFIED	

2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT
2b DECLASSIFICATION DOWNGRADING SCHEDULE	Approved for public release; Distribution is Unlimited

4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)

6a NAME OF PERFORMING ORGANIZATION	6b OFFICE SYMBOL (If applicable)	7a NAME OF MONITORING ORGANIZATION
Naval Postgraduate School	Code 54	Naval Postgraduate School

6c ADDRESS City State and ZIP Code	7b ADDRESS (City, State, and ZIP Code)
Monterey, California 93943-5000	Monterey, California 93943-5000

8a NAME OF FUNDING SPONSORING ORGANIZATION	8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c ADDRESS (City State and ZIP Code)	10 SOURCE OF FUNDING NUMBERS			
	PROGRAM ELEMENT NO	PROJECT NO	TASK NO	WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)

EXCELLENCE IN FLEET COMBAT REPLACEMENT SQUADRONS: PREDICTING CARRIER QUALIFICATION SUCCESS

12 PERSONAL AUTHOR(S)
Smith, Martin P.

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year Month Day)	15 PAGE COUNT
Master's Thesis	FROM ___ TO ___	1988, March	86

16 SUPPLEMENTARY NOTATION
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government

COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Excellence; Aviation Training; Fleet Combat Replacement Squadron; Carrier Qualification;

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

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20 DISTRIBUTION AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	Unclassified

22a NAME OF RESPONSIBLE INDIVIDUAL	22b TELEPHONE (Include Area Code)	22c OFFICE SYMBOL
Prof. Mark J. Eitelberg	(408) 646-2444	Code 54Eb

DD FORM 1473, 84 MAR   83 APR edition may be used until exhausted   SECURITY CLASSIFICATION OF THIS PAGE
All other editions are obsolete   UNCLASSIFIED

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#19 - ABSTRACT - (CONTINUED)

models for predicting fleet combat replacement carrier
qualification grades and advanced jet training command
carrier qualification grades are presented. Functions of
the model for a directed detailing capacity were given and
additional research topics were recommended.

#16 - SUBJECT TERMS (CONTINUED)

Pilot Training; Strike Aviation Training; Predicting
Carrier Qualification Success.

Excellence in Fleet Combat Replacement Squadrons:
Predicting Carrier Qualification Success

by

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Submitted in partial fulfillment of the
requirements for the degree of
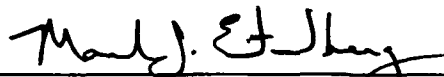
MASTER OF SCIENCE IN MANAGEMENT

from the

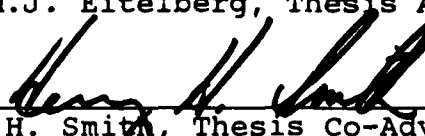NAVAL POSTGRADUATE SCHOOL
March 1988

Author: _____
                        Martin P. Smith

Approved by: _____
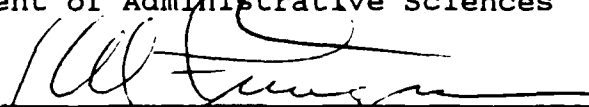   M.J. Eitelberg, Thesis Advisor

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                      James M. Fremgen,
               Acting Dean of Information and Policy Sciences

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ABSTRACT

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ACKNOWLEDGMENTS

I wish to thank each contributing officer for his time, interview, data compilation, and special insights into Fleet Combat Replacement Squadron Training. A special thanks goes to the Air Pac Landing Signal Officers, that contributed with their thoughts and "calls on the ball." I am particularly indebted to my co-advisors, Dr. Mark Eitelberg for his patience, guidance, and literary advice, and to Dr. Henry Smith for his motivation, direction, and friendship. I would like to thank my wife, Robin, and son, Sean, for persevering with me to the finish.

Finally, I'd like to dedicate this research to all Naval Aviators, past, present, and future and to my shipmates, Gregg, Ranny, Pete, Ed and Lanz. See you in marshall...

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I. INTRODUCTION

Since the beginning of Naval Aviation Training, a great deal of time and effort has been devoted to the selection and training of good pilots. A great deal of research has also been conducted to determine the mix of academic and flight-related talents required to produce a successful naval aviator. The result is a modern and complex training system that experiences continual review and revision to insure that quality training standards are maintained.

As technological advances in aircraft have changed the skills required of the naval aviator, so have the training systems changed to reflect these requirements.

One element has remained constant throughout the years. The naval strike aviator must attain the expertise and skills to land a complex aircraft on board a moving ship during the day or night under all types of weather conditions. It is this unique requirement that creates a special breed of pilot, set apart from other aviators.

The abundance of early research concentrates on the individual mental and physical aptitudes that help to produce this unique aviator. No prior work has looked at the role of the training organization in creating a good aviator, in particular, the special qualities or characteristics that distinguish an excellent training

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organization from one that is not. It was the lack of such a study that originally led to the research reported here.

If one conceives that a training organization is nothing more than a single item production facility, especially regarding the development of qualified naval aviators, the management and production issues associated with excellence of training can be evaluated. In its simplest terms, an excellent training organization meets its production goals on time and within budget, exceeding minimum quality standards.

This research explores both the management and product-related criteria for excellence in Fleet Replacement Pilot Training Squadrons.

Listed below are some of the questions that I asked myself and other naval aviators regarding the training experience.

How does one evaluate and accomplish training excellence in a fleet replacement squadron? Do excellence criteria for training units differ from those for operational units and civilian institutions? Are training failures something that we can predict and therefore avoid or are they the result of our personnel selection process? What are the effects of training techniques and system management? What constitutes a trained, fully qualified, fleet-ready Naval Aviator? How much training is enough? What type of training is most effective and least costly? What level of performance meets

the excellence criteria of the fleet and Air Warfare Commanders? Is an aviation candidate's aptitude of importance in determining trainability and potential performance? What qualities, if any, predispose an aviator's chance of success? Does each aviation warfare specialty have its own peculiar demands? Is one student aviator the same as the next? Do training delays have an impact on student success ratios? How do instructor style and attitude affect students?

As a thesis topic I decided to investigate the factors that may identify a successful aviation candidate, and how these factors interact with management and training technique to ultimately determine the "excellence" of training that occurs within our fleet replacement squadrons (FRS).

Because of my background as a tactical aviator, I decided to focus on carrier-based aviation training. There are clearly distinct differences between land-based and carrier-based aviation platforms. However, I believe the excellence criteria established within this thesis are universally applicable to fleet replacement squadrons and to all naval aviation candidates regardless of tactical or maritime platform.

Periodically, fleet aviation squadrons express concern over rising attrition rates, training delays, fleet accident rates and, ultimately, their resulting costs. These items,

among others, are discussed biannually at FRS training conferences. In fact, the discussions of an FRS training conference (held on 27 October 1987) provide much of the driving force behind this thesis.

The topic of excellence is explored through a two-part analysis of the aviator production process. Part one, including Chapters I, II and III, explores the managerial and behavioral foundations of what I have identified as "excellent" fleet combat replacement squadrons. Part two, presented as Chapter IV, investigates the accession and detailing practices followed by Naval Military Personnel Command and how they affect quality input and output of the system. Quantitative techniques were used to identify the most significant predictors for success in the FRS carrier qualification phase of training. Final results and recommendations are presented in Chapter V.

II. METHODOLOGY

My initial interest in this subject was sparked by personal training experiences, and by my discussions with other aviators, Navy and Marine Corp officers, and individuals concerned about training and readiness. Further thoughts on training and excellence were generated upon my reading of In Search of Excellence by Peters and Waterman [Ref. 1].

I proceeded to divide my study into two areas. The first, covered in Chapter II, details the qualitative criteria for excellence in a fleet replacement squadron (FRS). The second, in Chapter III, looks at quantitative factors that may indicate an individual's chance for success in the carrier landing qualification phase of FRS training.

For the qualitative portion of the study, the director for FRS's, OP-593, and each West Coast FRS commanding Officer were interviewed and asked what determines "excellence" in an FRS. These senior officers were all Commanders or Captains and recognized as accomplished and outstanding individuals in their respective Air Warfare Specialties. Specifically, they were asked :

1. What criteria would you apply to determine how well an FRS is accomplishing its mission?

2. What characteristics describe an excellent FRS?

3. Does command environment affect student aviator training performance?

4. To what variables do you attribute the variances in student aviator performance?

5. What do you feel is the primary constraint in accomplishing your mission?

6. What internal system criteria, if any, would you modify to help accomplish your mission?

In the quantitative section of the study, the focus was on inherent individual characteristics and flight training performance that may indicate a student aviator's propensity for future success at the fleet replacement carrier qualification phase.

The thesis sponsor, CNO (OP-59), initiated a review of the Category 1 strike pilot training syllabus. (A category 1 strike pilot is an individual preparing for his first fleet tour in a carrier-based tactical aircraft.) This review evaluated the current status of the accession program, Training Command (TRACOM) product quality, Naval Military Personnel Command (NMPC) detailing policy, FRS syllabus requirements, and training indicators associated with FRS attrition. Data were collected for all United States Navy tactical aviation category 1 (TACAIR FRS CAT 1) pilot candidates who underwent training during fiscal 1986 and 1987. The specific information requested was:

1. FRS Class Date

2. Instrument Syllabus Grade

3. Weapons/Tactics Syllabus Grade

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4. Carrier Qualification Grade

5. Downs/Reason

6. Composite Score

7. Must Pump/Criteria

8. Total Flight Hours

9. Previous Tour/Flight Experience

Comments on current accession policy, TRACOM product quality, SERGRAD program, Interservice Transfer/Warfare Transition program, and training pipeline requirements were solicited.

The data were inspected and discrepancies eliminated to produce a sample of 445 student aviators who began and completed their strike pipeline training during this two-year period. Linear regression analysis was conducted using selected independent variables to determine their relationships and significance to performance score variation in the FRS carrier qualification phase. Additionally, the phase performance grades of 738 Training Command students were examined to determine if they were related to advanced jet training phase carrier qualification grades in the T-A4 aircraft.

The conclusions and policy recommendations of the study (Chapter V) were based on the results of the regression analysis and the statistical relationships of the predictor variables with the dependent variable, FRS carrier qualification grade.

III. QUALITATIVE CRITERIA OF EXCELLENCE

In determining the qualitative factors of excellence for an FRS, it was apparent that many of the variables were strictly organizationally related. Investigation into the phenomenon of excellence within an organization reveals that the unit, like a diamond, is only as brilliant as its different facets. What appears to be solely organizational structure and behavior is actually a sum of individual elements.

My personal experiences and observations in coaching and aviation training have influenced the approach taken in this research. Having been a member of an extremely successful high school football coaching staff, I realized that it wasn't just the talent one had to work with that made for a good season. More important was how the organization was structured, how it functioned, and how the staff and students were trained and motivated. Time and again I witnessed the success of the less talented in the face of stronger, larger opponents. Success was the result of the organization, its training techniques, and the internal motivation of its staff and students.

My naval aviation training experiences have reinforced this observation. It was not always the smartest or the most physically talented student aviator that rose to the

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top of the class. Likewise, it was not the fainthearted or cautious or even the proverbial "Box of Rocks" that failed to complete the syllabus. The sharpest FRS student was not necessarily the fleet ace, and neither was the marginal graduate always the weak sister of the squadron.

Why did such performance variances occur and what was their origin? Many of these questions are indeed answered by the statistical analysis performed in Chapter IV. The question addressed in Chapter II is: "What made the dud a stud and vice versa?"

Several past studies on excellence shed light upon the effects of qualitative factors in the excellence equation. Most notable of these is the study that produced the best seller, In Search of Excellence, by Thomas J. Peters and Robert H. Waterman [Ref. 1]. In this study, the most productive and successful companies in America were evaluated and found to exhibit similar organizational and behavioral characteristics. Among the common characteristics that Peters and Waterman identified were the following:

1. bias for action
2. ability to manage ambiguity and paradox
3. autonomy and enterprise
4. productivity through people
5. hands-on value-driven experience

6. stick-to-it attitude

7. simple form/lean staff

A 1985 Master's thesis by LT. Homer J. Coffman, USN, under the direction of Dr. Rueben Harris, focused on the determining factors of excellence in tactical readiness staffs. Seven criteria were earmarked by LT. Coffman as necessary in attaining excellence. They were: consistency, competence, climate, coaching, communication, conceptualization, and credibility [Ref. 2]. These were quite similar to the 7-S Framework for excellence generated by McKinsey in In Search of Excellence (including structure, strategy, systems, skills, style, staff, and shared values).

A third, and probably more applicable study, was conducted by Captain Hugh A. Ford, USAF. In his 1985 Master's thesis, Captain Ford examined the factors of excellence in tactical fighter squadrons. He concluded that six characteristics were found in all excellent fighter squadrons. These were: excellent top-down ıdership winning attitude, training to fight, teamwork, universal leadership, heritage, and high standards [Ref. 3].

To generate my criteria for excellence in fleet replacement squadrons, I began by studying these past results. I hypothesized that for a fleet replacement squadron to be excellent it must organizationally exhibit the following characteristics:

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1. top-down excellent leadership

2. action bias

3. realistic training opportunities

4. autonomy and entrepreneurship

5. hands-on experience

6. coaching instructors

7. electric enthusiasm

8. motivated, talented students

This study concentrates on FRS assets associated with strike aviation or the production of tactical aviators. However, it is equally applicable to maritime patrol and other naval aviation training assets. The factors hypothesized to be of critical importance for excellence in tactical aviation training units are universally applicable to other aviation pipeline training programs. Having observed both types of training, I am convinced that the rigors of naval aviation training are equally demanding on both types of student aviators.

A. COMMAND ENVIRONMENT

At no time is the command environment and its leadership effects more apparent than upon a visitation to a squadron. From the physical appearance of the facility to the readiness and willingness of the duty officer to get you to your appointment, the command environment and its concerns about people are continually reinforced.

There is an unmistakable attitude associated with a winner. It is not cocky or brash, but confident, unassuming, cooperative, and open. You notice it in the spaces, classrooms, and personnel. The people smile, they're helpful, courteous, and concerned. It's apparent in the way people walk, how they talk, or in the "cut of their jib." An excellent FRS isn't uncomfortable with an outsider's presence.

No matter what a commanding officer may have told me about environment and its effects upon his FRS, the proof was in how the command's personnel greeted and accommodated its guests. The excellent FRS command is inundated with a positive attitude and environment. If you feel as important as an Admiral when you leave the duty office, you know the command creates a positive relationship with its people. The old adage, "if it looks like a duck, smells like a duck and walks like one, it probably is a duck," is ever so true. First impressions do create a special aura; but at the same time, they cannot make up for an ailing organization's weaknesses.

An excellent FRS has the look, smell, and feel of success. It's difficult to describe, but you know it's there. Typically, the physical facility sparkles, and the surrounding atmosphere is noticeably positive. Furthermore, if I felt important and impressed upon leaving the duty

office, I was likewise impressed throughout all elements of the organization.

B. TOP-DOWN LEADERSHIP

I had the opportunity to talk with an old flying mate about my thesis and the effects of leadership upon FRS units and the quality of training being produced. He shared with me the experience of a flight up the West Coast. He recalled a familiar Air Wing CO and noted that, in switching radio channels during a flight, he had heard a familiar call sign and voice check in the elements of his division as they rendezvoused. He went on to comment how impressed he was with the "old man" and that he was still right out there with his finger on the pulse of the training within his unit.

Excellence in the FRS, like excellence in operational squadrons, starts at the top. Strong top-down leadership is fundamentally essential to the existence of excellence in a fleet training unit. FRS commands are post-operational assignments for most CO's. Each man enters the arena with a reputation for expertise and excellence within his air warfare specialty. The commanding officer's credibility is instantaneous. The excellent FRS leader seeks to build upon this credibility, not rest upon it. He is out in front and highly visible. He flies whenever possible. He is involved and close to the pulse of the unit. MBWA (management by walking around) is practiced. The commander is out among

the junior officers and department heads. His visibility and presence is not misunderstood, but appreciated. MBWA becomes a positive macro-management technique, rather than micro-management snooping. He demonstrates true concern and has an ear for what is going on. The excellent commander is visible at FRS functions, after hours in the lounge, involved in squadron competitions and other get-togethers. It is his accessibility and enthusiasm that make it happen for the FRS. He sets the example to be emulated and the atmosphere for the unit and its training effectiveness. His model carries over to his staff and instructor corps. Those FRS's that were excellent had commanding officers that did just these things. There is an old saying that "winners breed winners." In the case of the excellent FRS, the CO being a winner is likewise transferred to the department heads and staff.

The commanding officer sets the standards for the FRS. The training accomplished is a reflection of these standards. If his attitude about training is positive and his commitment to excellence is positive, so are the results. He enforces and adheres to his standards and policies. He meets his commitments and makes the most out of his resources and talent pool.

The excellent FRS commanding officer ensured there was appropriate reward and acknowledgment for jobs well done. From the smallest to the most visible contributor, each felt

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his actions were noticed and appreciated by the command. Honesty and integrity permeate the excellent FRS. This attitude begins at the top. Mistakes are used as learning tools to help students and staff become better pilots and instructors.

The effect of the commander's leadership is contagious. It can have either a positive or detrimental effect upon the unit. Those FRS's that seemed excellent had the strongest and most positive leadership at the top.

C. UNIVERSAL LEADERSHIP

Along with strong top leadership, the excellent FRS demonstrated leadership excellence throughout its structure. The staff, instructors, and Petty Officers upheld the qualities and standards of the "brass." Wherever I went, I was addressed as "Sir" and could see the drive for perfection and learning in student activity.

Instructors were tuned into what was going on with the students and the needs of the fleet. The student-instructor relationship was not antagonistic but could be characterized as a coach-player relationship. Everywhere, at all levels within the command, individuals sought to help others accomplish their goals. Learning was not accomplished solely on an individual basis, but as a unit. Strong positive leadership throughout the system reinforced the single team concept.

Two-way communication was everywhere. All personnel in the command felt in touch and part of the team. The primary objective was "train 'em and launch 'em."

Failures occur in every FRS flight syllabus. However, the excellent FRS did not accept failure of any kind lightly. Regular jacket reviews (flight record performance reviews) covering past and present student performance were conducted upon entry and completion of each flight training phase. Weaker students were counseled, and, when possible, additional attention was afforded the individual to "bring him up to speed" prior to embarking into increasingly difficult and rigorous training evolutions.

Most impressively, the standardization boards weren't viewed as the "bad guys" by the students. Instead, the majority of students felt that instructors were just attempting to straighten out bad habits or correct potentially dangerous deficiencies.

D. BIAS FOR ACTION

The successful and excellent FRS was obsessed with the "make it happen" attitude. No task was too great and no problem was impossible to resolve.

Whether in maintenance, operations, or training, all levels of the excellent FRS were characterized by the "let's find a way to do it" philosophy.

Maintenance officers were oriented to making more ready aircraft than operations had instructors or students to fly.

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Training began as soon as humanly possible after an individual checked into the command. The less time spent waiting, the better.

Meeting pilot training requirements (PTR) was a given. Finding the way to get there was the constraint. I didn't hear anyone complain about how "we can't make our goals because of this constraint or that." Instead, the common feeling was "it's a challenge and somehow we'll do it." The "can do" spirit was alive and well in the excellent organizations.

From top to bottom the successful FRS command was action-oriented. When faced with a difficult problem, long drawn-out analysis was viewed as indecisive and negative. The imperative was to move forward, to go in what appeared to be the best direction and to work through the problems as encountered. Hindsight was a learning tool to help determine how things might be better accomplished in the future and how pitfalls could be avoided. The process of the decision itself was the focus of attention. Decisions were never criticized on the basis of results.

The successful FRS's worked constantly to get better, realizing there would be mistakes and corrections, utilizing errors as tools for future reference but never for admonishment.

In short, it was apparent that the excellent FRS would pursue some action when faced with a dilemma or training

situation. The worst alternative was to sit tight and do nothing. The excellent FRS made it happen.

E. TRAIN TO FIGHT

Although the opportunities to engage in realistic air warfare subspecialty training vary greatly among aviation communities, the best FRS's sought to maximize every flight and trainer hour as a realistic training exercise. Throughout the system, I can honestly report that every hour of flight time flown was for a specific purpose. Every flight purpose code was realized, and then some.

The best FRS's sought to maximize conditions that might preclude primary scheduled activities. If the weather didn't permit range time, then instrument instruction or approaches were flown. If the weather was too hot to run a weapons detachment in one area of the country, an alternate range was used. There was always a back-up scenario. A pilot could count on a mission regardless of what mother nature had to offer.

Day/Night field carrier landing practices (FCLP) often made use of hot switches and turnarounds where feasible. Maximum passes were afforded all category pilots. Those individuals who were behind in landing skills were provided extra passes when feasible or at the end of a session.

In FRS's with extensive weapons system trainers (WST), every attempt was made to make simulated mission profiles

realistic. This began with full-fledged briefs and concluded with thoughtful and introspective debriefs.

Extensive instrument flying techniques were practiced and evaluated. Relatively large amounts of night flying were required prior to night FCLP practice sessions.

If flight crews were utilized within the community, crew continuity was stressed and maintained whenever possible. Maximum exposure to every threat scenario was employed throughout the syllabus. One interesting occurrence was in a WST in which the instructor informed the crew that the requirements had been accomplished and it was now time to play "what if" scenarios.

Right down to the take-off and landing checklists and aircraft-to-controller communication, the best FRS's trained as realistically as possible. Indeed, the excellent FRS met the old axiom that "you play like you practice." They trained the way the would fight and the way they felt their adversaries would engage them.

F. AUTONOMY AND ENTREPRENEURSHIP

Never tell people how to do things. Tell them what to do and they will surprise you with their ingenuity.

George S. Patton

Perhaps General Patton said it best, confirmed by my interviews and travel, the excellent FRS is one that is allowed to exercise functional discretionary judgment in its operations. The old bugaboo, micro-management, was not a

problem. The excellent FRS was one in which the Department Heads and Junior Officers had the autonomy and flexibility to meet their problems head on. Their methods were not challenged. The "bottom line" was what counted.

The majority of commanding officers echoed Patton's observation. Although very interested in the daily workings of their unit and its flight training syllabus, they desired that their subordinates tackle management problems in a straightforward manner. Demonstration of ingenuity and resolve were considered extremely important in evaluating subordinate performance.

Given this autonomy and flexibility, the FRS is a natural environment in which the talents of the staff can be fully appreciated. The very nature of the selection process for instructors insures that only the top 1 percent of the officer corp is eligible for FRS duty. This is further limited by the fact that normally an aviator must be either the number 1 or 2 Junior Officer in his command to earn a position in the FRS as an instructor. The result of these detailing policies is an absolutely remarkable pool of experience and raw talent being collected at one point for the purpose of training new aviators in an air warfare subspecialty. Furthermore, these individuals are fleet experienced. They know how the weapons platform and system are used in the real-world. They know the real-world threat to their platform and its real-world limitations. Their

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unequalled knowledge of the system and tactical perspective give the command an unmatched resource for tackling training problems and developing realistic training scenarios and programs.

Most commanders decidedly felt that, if their staff couldn't solve a problem, then the question was probably misstated or misunderstood.

With their collection of top-guns, no problem was deemed unmanageable or impossible to resolve.

G. HANDS-ON EXPERIENCE

There is no substitute for the real thing. The excellent FRS had both an abundance of real world experience on staff as well as realistic training opportunities.

The hands-on real-world experience of the excellent FRS instructors was transferred to the maximum extent possible by incorporating realistic flight training and weapons system trainers. The excellent FRS encouraged its aviators to go the extra mile, to get dirty, to look beneath the panels on aircraft, to visit the various avionics and aircraft branch work centers, to find out what makes the black boxes tick. Additionally, in the excellent FRS, informal think tanks were evident. These were aviator sessions, typically informal, often one-to-one, and no more than five or six individuals and an instructor discussing tactics, maintenance, avionics, and aircraft systems. These sessions weren't held in classrooms, but in the hanger bay,

in the ready room, or in the local waterhole. They were undoubtedly the best transfers of the "gouge" on the real-world experience the FRS student could expect.

The excellent FRS also incorporated into its syllabus a tactical application scenario. This dealt with threat assessment, weapons system utilization, weapons engineering, and strike planning. I've often heard criticism of this approach, it can be one of the most rewarding and motivational programs that student aviators are involved in. Students generally reported that they felt they would master the NATOPS Manual and CV NATOPS. What they really wanted was a peek at the real world and what the tasking and utilization picture looked like. They wanted a preview of the real thing for themselves.

The excellent FRS made the opportunity for this real-world look and exchange of information possible through a formal syllabus program or through informal exchange between students and instructors, as previously mentioned. This opportunity was visible in each excellent FRS visited.

H.   COACHES: THE CRITICAL DIFFERENCE

There is no magic; only people who find and nurture champions, dramatize goals and direction, build skills and teams, spread irresistible enthusiasm. They are cheerleaders, coaches, story-tellers and wanderers. They encourage, excite, teach, listen, facilitate. Their actions are consistent. Only brute consistency breeds believability. They say people are special and treat them that way--always. You know they take their priorities

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seriously because they live them clearly and visibly; they walk the talk. [Ref. 4]

<div align="right">Tom Peters and Nancy Austin</div>

"Walk it like you talk it," an old coaching sage used to tell me. How true it is with respect to the FRS business. Peters and Austin express it clearly in Passion for Excellence.

Unequivocally, the excellent FRS is staffed with these kinds of people. LT. Coffman, in his 1985 thesis, Essence for Excellence, noted that coaches were the critical edge.

If I could focus on any single differentiating factor between the excellent FRS and the average one, it would be the existence of these "quality" personnel from the commanding officer to the first lieutenant.

When you sit with the CO, a staff member, or an instructor you can feel it. The smell of JP-5 (jet fuel) is ever present. These people exude confidence. They enjoy what they do. It's contagious. They create excitement. I identify it as a simple raw passion for the work at hand and Naval Aviation. The excellent FRS, with this staff and learning environment, makes the others pale in comparison.

Peters and Austin describe the coaching role as follows:

Coaching is face to face leadership that pulls together people with diverse backgrounds, talents, experiences and interests, encourages them to step up to responsibility and continual achievement, and treats them as full scale partners and contributors. Coaching is not memorizing techniques or devising the perfect game plan, its about really paying attention to people, really believing in

them, really caring about them, really involving them. [Ref. 4]

The excellent FRS instructor-student relationship epitomizes this. Students feel like contributors and partners in a larger scheme. Instructors realized they had a vested interest in their students' performance and learning. Admonishments are rare. The environment was one in which students worked to "get better." The excellent FRS worked on eliminating the weaknesses of its students. They were not coddled by any means. The professional camaraderie of the unit encouraged the "get better" desire in each student. The student's vision of "get better" was actually "get perfect," and they worked hard to make it happen.

I. ELECTRIC ENTHUSIASM

The excellent FRS had an "electric" atmosphere. There was a passion for flying and the mission in everyone on board. When on the flight line and aircraft entered the break, all eyes were riveted skyward.

This passion wasn't apparent only during flight hours but after hours as well. In the pub or in the ready room, hands gestured relative positions of aircraft as each day's experiences were debriefed and analyzed.

The syllabus was as much informal art as quantitative wickets through which all must jump. Everyone expected to make the minimum requirements, but everyone wanted to be the best.

There was a real thirst for real-world experience and the sharing of "sea stories." The greatest knowledge here wasn't to be found in manuals or books, but in the people, the CO or XO, and the instructors.

In the excellent FRS, all on board seemed to await the next day's events with positive anticipation. If flying was permitted on weekends, the schedules officer had to fight off students for flight schedule requests.

However one chooses to name this emotional climate, it must be noted that it was uniform and consistent. These people enjoyed their work. It can best be characterized as raw enthusiasm or natural excitement. It is real NAVAL AIR.

J. TALENT

A great deal of controversy exists on the importance of talent. Every FRS has its fair share of top-guns among instructors and students alike. The manning policy for instructors ensures that only the "cream of the crop" are chosen. Many FRS's preclude detailing of student aviators with less than a minimum TRACOM composite score. This is discussed in depth in Chapter IV.

The excellent FRS did not focus entirely on the quality of the student aviators it received. Instead, it focused on how to bring everyone up to speed, how to make everyone better.

I do not brush off lightly any of the current assignment policies. Indeed, in this era of increasingly complex

weapon systems and aircraft, ability and past performance must certainly have a bearing on a student aviator's ability to complete the syllabus and how safe and proficient he will be in the fleet. However, the excellent FRS does not dwell on the aviator's past performance. Instead, the full tool chest of the FRS is brought to bear in the training process. Early problems are identified and rectified when feasible. The sooner difficulties are acknowledged, the easier and less costly they are to remedy.

Additionally, there are distinct differences between communities of single-and multi-seat aircraft which allow the multi-seat communities to approach handling their weaker students in a different manner. They can be "brought along" more readily.

Perhaps, the most important factor is the internal motivation level of the student aviator. What makes him want to be a Naval Aviator? I had the opportunity to sit and talk with an old flying mate while at the Pentagon working on this thesis. He had instructed at every level in the cockpit and FRS. His perception was that Naval Air Training was the best it could possibly be. He felt that the reasons for trainee attrition weren't to be found in the syllabus, but in the student's psyche. He suggested that, if one really wanted to discover what exactly motivated Naval Aviators, I should interview everyone at the Tailhook Convention for several years running. "There is some common

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motivational thread that runs between those that complete the syllabus and those that are in the fraternity," he remarked. "If you can find it, you've got the secret."

The student aviator in the excellent FRS was highly motivated, had caught the fever of his command, worked daily to improve himself and reach perfection, and was indistinguishable motivationally from the top-gun of the unit.

IV. QUANTITATIVE CRITERIA

From the beginning of aircraft development, and the subsequent integral role of pilots in both military and civilian air transportation systems, there have been efforts made to enhance the selection of potentially successful candidates for aviation training. Criteria for selection focused upon both mental and physical characteristics deemed conducive to successful flight training. The high costs associated with aviation training and the subsequent high attrition rates of the early and present years (with the resultant monetary expenditures) justifies continual research into refinement of selection criteria for identifying aviation candidates with the greatest probability for successful completion of training. The current cost of training a successful aviation officer candidate is estimated at $322,000 and represents only the expenditure required to complete undergraduate flight training. Additional training at the graduate level, fleet combat replacement air wings (FRS), can easily double this expenditure. [Ref. 5]

There is presently a relatively sizable overall attrition rate among trainees in Naval Flight Training. Griffin and Mosko estimated a 30 percent attrition rate during the 1962 to 19,7 timeframe. Currently the rate of

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attrition is about 25 percent overall and 5 to 10 percent at the FRS (graduate level) training level. These rates appear large but are, in fact, quite small when compared to the estimated 60 percent attrition rates experienced during World War II [Ref. 5]. Nevertheless, the approximate 1-in-4 failure rate for trainees considering today's economic climate, still represents an unacceptable cost for Naval Aviation Training.

A similar study, entitled <u>A Method For Predicting Carrier Qualification Success In the Combat Replacement Air Wing</u>, was conducted by David Wesley Hoffman as his Master's Thesis in 1973 [Ref. 6]. In his study, Hoffman concentrated upon F-4 replacement pilot candidates and the correlation between advanced familiarization and instrument grades at the FRS level and ultimate carrier qualification grades earned by the control group. He found that advanced instrument and familiarization scores were significant and positively correlated with satisfactory levels of carrier qualification performance. Additionally, he concluded that if certain minimum standards were enforced, 100 percent of the sample's observed attritions could be eliminated. His final recommendation was that additional study be conducted upon earlier TRACOM grades and a determination be made as to their relationship with fleet combat replacement air wing carrier qualification grades.

The Naval Aviation Research Medical Laboratory (NMRL) has conducted numerous research projects that deal closely with this concept. A study conducted in 1970 at NMRL by Bale, Rickus, and Ambler concluded that successful carrier qualification could be reliably predicted utilizing an aviator's past performance scores in Training Command and the Fleet Combat Replacement Air Wing. Those predictors that were deemed most significant were generically associated with the combat-skills phases of training [Ref. 7].

Another study, conducted by Shannon and Waag at NMRL in 1973, arrived at a similar conclusion. Shannon and Waag found that Fleet Replacement Air Wing grade performance could be reliably predicted utilizing seven variables (experience level, formation, transition, FAR[1], AQT[2], Basic Instruments, Instrument Navigation and Carrier Qualification). Their multiple R^2 of .513, though not extremely high, indicates that a good deal of performance variation can be traced to past performance ratings. [Ref 8]

It is the objective of this research to build upon the previous analyses and hypotheses that advanced instrument grades, advanced weapons grades, and past flight phase

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[1] Flight Aptitude Rating

[2] Aviation Qualification Test

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performance are highly correlated with ultimate carrier qualification scores. If these relationships prove to be significant, the potential for directed detailing policy applications is considerable.

Identifying those candidates whose skill acquisition rate and cognitive processing will not meet the demands of the increasingly technical cockpit and demanding tactical environment should result in considerable reductions in flight training expenditures.

A. METHODOLOGY

The investigation into factors affecting attrition rates in category 1 strike aviation was commissioned by OP-59. This research attempts to quantify some of the performance and mental characteristics associated with successful completion of the "strike" syllabus.

The data utilized in this study were collected by direction of the CNO (OP-59) during November/December 1987. They represent a cross-platform, category 1 strike pipeline database, constructed explicitly for the purpose of this study.

Specifically, data were requested upon all FRS (graduate level) pilot training candidates over the fiscal 1986 through 1987 period. One-hundred percent of Strike FRS units submitted the requested data. A resulting database of 1,238 training command and FRS strike pilot trainees was generated by the collection procedure. After cleaning up

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the data and eliminating inconsistent and missing information, the sample size reduced to 445 total fleet replacement pilot trainees and 637 training command observations.

Considerable difficulty emerged in attempting to match training command records with fleet combat replacement records for two primary reasons. First, many records contained the last four digits of social security numbers or none at all. Second, by nature of the dates of the data request, not enough overlap was provided between training command and fleet combat replacement recording periods. The result was that a total of 157 training command records were matched with fleet combat replacement records.

A third, less serious problem was that two of the fleet combat replacement squadrons forwarded ordinal data for instrument phase scores in place of cardinal point scores.

A fourth and final problem was an apparent anomaly in the data associated with one community, the A-6 Medium Attack aircraft, that will be discussed in fuller detail during the descriptive and analytical portion of this chapter.

The information requested included:

Pilot Name

Social Security Number

FRS Class Commencement Date

FRS Graduation Date

Attrition Date (if applicable)

Attrition Reason (if applicable)

Flight Downs (negative evaluations)

Previous Tour (Sergrad, VC, Warfare Change)

Total Flight Hours

Must Graduate Criteria (y/n)

Instrument Grades

Weapons/Tactics Grade

Carrier Qualification Grade

Through application of statistical analysis and linear regression procedures, the objective of this study was to determine if a significant correlation existed between elements of the flight phase grades requested and variations in carrier qualification performance in the FRS syllabus. Three quantitative models were generated to analyze FRS, TRACOM, and cross data set relationships.

Successful completion of the FRS syllabus in the Strike Aviation Pipeline includes NATOPS Qualification in strike aircraft (A-6, A-7, F-14, F/A-18, S-3, E-2) and successful day and night carrier landing qualification in assigned aircraft. The replacement pilot, upon completion, is a considered fully operational and a qualified asset for squadron assignment and fleet deployment.

Additionally, FRS comments were solicited pertaining to aviation assignment policy, quality requirements,and specific problem areas associated with each FRS. Comments

upon current aviation accession policy, TRACOM Product Quality, Interservice and Warfare Transition Programs, SERGRAD Program, and training pipeline requirements were welcomed.

Table 1 represents the sample averages and standard deviations found for all strike aircraft at the FRS level of training. Phase grades evaluated included instrument grades, weapons grades, and carrier qualification grades.

The A-6 instrument grade averages and standard deviations include data collected from the East coast replacement squadron only. This was required because ordinal data were received from the West coast unit. Likewise, the same problem was encountered with the EA-6 FRS. Because the EA-6 is an electronic warfare platform, no weapons phase grade is available. A similar situation occurs in the E-2 community because the training syllabus requires no weapons system training. These data points are indicated as "not available" in the tabular display of information.

Table 2 shows the sample averages and standard deviations for the 11 TRACOM data points that were used in the regression.

The composite score average in Table 2 is the sum of the unadjusted and weighted flight phase averages. This includes overall Basic Flight Phase, Intermediate Flight Phase, and Advanced Jet Flight Phase Grades.

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TABLE 1

FLEET REPLACEMENT SQUADRON PHASE PERFORMANCE GRADES AND STANDARD DEVIATIONS (S.D.) BY AIRCRAFT DETAILING ASSIGNMENT[a] (PLATFORM)

Squadron Phase Performance Grades and S.D.

PLATFORM	INSTRUMENT		WEAPONS		CARRIER LANDING	
	GRADE	S.D.	GRADE	S.D.	GRADE	S.D.
A-6[b]	3.30	.21	3.02	.59	2.67	.77
EA-6	N/A	N/A	N/A	N/A	2.78	.36
A-7	3.03	.11	3.13	.05	2.77	.49
F/A-18	3.06	.46	3.06	.46	2.92	.46
F-14	3.02	.26	2.94	.56	2.80	.61
S-3	2.97	.43	2.96	.43	2.79	.43
E-2	2.98	.39	N/A	N/A	2.76	.39
Fleet avg.	3.06	.31	3.02	.41	2.78	.50

a) Data obtained through CNO (OP-59) survey.
b) East coast A-6 FRS data only
N/A = not available

TABLE 2

TRAINING COMMAND DESCRIPTIVE SUMMARY FOR BASIC,
INTERMEDIATE, AND ADVANCED FLIGHT PHASE GRADES[a]

Phase Grade	Mean	Standard Deviation
FAR[b]	7.56	1.45
AQT[c]	5.61	1.27
T34 Flight	3.06	.03
T-2 Jet Aircraft		
Instrument	3.04	.02
Carrier Landing	2.99	.06
Flight	3.03	.02
A-4 Jet Aircraft		
Instrument	3.05	.05
Weapons	3.05	.04
Carrier Landing	2.97	.05
Flight	3.04	.02
Composite Score	211.10	28.80

a) Data obtained through CNO (OP-59) survey.
b) FAR = flight aptitude rating score
c) AQT = aviation qualification test score
   T34 = T-34 training aircraft
   T2 = T-2 jet aircraft
   A4 = A-4 jet aircraft

Tables 3 and 4 present TRACOM phase performance grades and standard deviations for each strike aircraft community and its assigned TRACOM graduates. Students reassigned to the training command as instructors on a case-by-case performance basis are included for comparison purposes. They are indicated in the SGRAD category. The relationship of each community's phase performance scores to the sample mean (fleet average) can be observed by comparing the bottom row of data with the corresponding phase averages for each community.

Tables 5 and 6 provide a summary of the percentage of student pilots assigned to each strike aircraft community that were below the fleet average for each phase performance grade and the percentage of these individuals who were at or below the one standard deviation point from the fleet mean.

These numbers are important. The overwhelming percentage of attritions and training problems encountered in the FRS's were related to individuals that were at or below one standard deviation from the fleet average in phase performance grades.

B. DEPENDENT VARIABLE SELECTION

The dependent variable, fleet combat replacement carrier qualification grade (CQGRD), was chosen because it represents the most critical and final accomplishment of the aviator's completed training syllabus. The ultimate success of the entire training syllabus depends on whether or not

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TABLE 3

TRAINING COMMAND PHASE PERFORMANCE GRADES AND STANDARD
DEVIATIONS BY AIRCRAFT DETAILING ASSIGNMENT[a]

AIRCRAFT	Training Command Phase Performance Grades[b]					
ASSIGNED	FAR	AQT	T34FLT	T2INST	T2CQGRD	T2FLT
A-6[c]	7 (1.4)	5 (1.4)	3.06 (.02)	3.03 (.02)	2.99 (.03)	3.03 (.01)
EA-6	7 (1.2)	5 (1.1)	3.06 (.02)	3.04 (.02)	3.0 (.02)	3.03 (.01)
A-7	7 (1.4)	5 (1.2)	3.06 (.02)	3. ⁖ (. ⁖)	3.0 (.02)	3.03 (.01)
F/A-18	7 (1.4)	5 (1.3)	3.08 (.03)	3.05 (.02)	3.0 (.02)	3.05 (.02)
F-14	7 (1.4)	5 (1.3)	3.06 (.02)	3.04 (.02)	2.99 (.09)	3.04 (.01)
S-3 VR/VQ	7 (1.5)	5 (1.2)	3.05 (.02)	3.03 (.02)	2.99 (.03)	3.03 (.01)
VC	6 (1.7)	5 (1.2)	3.04 (.02)	3.02 (.02)	2.99 (.02)	3.02 (.01)
SGRAD	7 (1.3)	5 (1.0)	3.07 (.02)	3.05 (.02)	2.99 (.10)	3.04 (.01)
Fleet avg.	7 (1.4)	5 (1.2)	3.06 (.03)	3.04 (.02)	2.99 (.06)	3.03 (.02)

Standard Deviations in parentheses ( ).
a) Data obtained through CNO (OP-59) survey.
b) The following abbreviations are utilized :
   FAR = flight aptitude rating
   AQT = aviation qualification test score
   T34FLT = T34 basic flight grade
   T2INST = T2 intermediate instrument grade
   T2CQGRD = T2 carrier qualification grade
   T2FLT = T2 intermediate flight grade
c) East coast FRS data only

TABLE 4

TRAINING COMMAND ADVANCED JET PHASE PERFORMANCE GRADES AND STANDARD DEVIATIONS BY AIRCRAFT DETAILING ASSIGNMENT[a]

AIRCRAFT	Training Command Performance Grades[b]				
ASSIGNED	A4INST	A4WEPS	A4CQGRD	A4FLT	COMPSCR
A-6[c]	3.05 (.02)	3.05 (.03)	2.95 (.05)	3.04 (.01)	207.16 (24.71)
EA-6	3.05 (.02)	3.05 (.02)	2.98 (.04)	3.04 (.01)	212.01 (17.07)
A-7	3.05 (.02)	3.05 (.03)	2.99 (.05)	3.04 (.01)	211.69 (16.33)
F/A-18	3.06 (.02)	3.08 (.04)	2.99 (.04)	3.05 (.01)	239.39 (30.53)
F-14	3.05 (.02)	3.06 (.03)	2.98 (.05)	3.04 (.01)	217.29 (23.23)
S-3 VR/VQ	3.03 (.08)	3.03 (.03)	2.95 (.05)	3.03 (.02)	189.46 (22.62)
VC	3.03 (.02)	3.03 (.03)	2.95 (.06)	3.02 (.01)	174.66 (24.68)
SGRAD	3.06 (.02)	3.07 (.03)	2.98 (.04)	3.05 (.01)	233.31 (15.42)
Fleet avg.	3.05 (.05)	3.05 (.04)	2.97 (.05)	3.04 (.02)	211.10 (29.80)

Standard Deviations appear in parentheses ( ).
a) Data obtained through CNO (OP-59) survey.
b) The following abbreviations are utilized :
   A4INST = A4 instrument grade
   A4WEPS = A4 weapons grade
   A4CQGRD = A4 carrier qualification grade
   A4FLT = A4 advanced jet flight grade
   COMPSCR = unadjusted training command composite score
c) East coast FRS data only

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TABLE 5

PERCENTAGE OF TRAINING COMMAND GRADE OBSERVATIONS BELOW
FLEET PHASE AVERAGE BY AIRCRAFT DETAILING ASSIGNMENT[a]

Training Command Grade Observation Points[b]

AIRCRAFT ASSIGNMENT	T34FLT	T2INST	T2CQGRD	T2FLT
A-6[c]	18 (9)	48 (39)	23 (10)	47 (3)
EA-6	8 (0)	46 (29)	24 (0)	11 (0)
A-7	44 (4)	38 (32)	25 (0)	13 (0)
F/A-18	30 (0)	24 (23)	13 (0)	9 (0)
F-14	46 (0)	39 (12)	29 (2)	42 (0)
S-3/VR VQ	65 (21)	56 (41)	30 (3)	75 (11)
VC	78 (9)	82 (39)	30 (0)	74 (4)
SGRAD	25 (1)	36 (3)	20 (2)	4 (0)
Fleet avg.	3.06 (.03)	3.04 (.02)	2.99 (.06)	3.03 (.02)

Percentage of below average observations greater than 1
Standard Deviations from the mean appear in parentheses ( )
a) Data obtained through CNO (OP-59) survey.
b) The following abbreviations are utilized :
   T34FLT = T34 basic flight grade
   T2INST = T2 intermediate instrument grade
   T2CQGRD = T2 carrier qualification grade
   T2FLT = T2 intermediate flight grade
   VC = fleet composite squadrons
   SGRAD = students reassigned as flight instructors
c) East coast FRS data only

TABLE 6

PERCENTAGE OF ADVANCED TRAINING COMMAND GRADES BELOW FLEET
PHASE AVERAGE BY AIRCRAFT DETAILING ASSIGNMENT[a]

AIRCRAFT ASSIGNMENT	Training Command Grade Observation Points[b]				
	A4INST	A4WEPS	A4CQGRD	A4FLT	COMPSCR
A-6[c]	40 (0)	34 (17)	62 (38)	45 (0)	54 (31)
EA-6	27 (0)	43 (0)	32 (0)	30 (0)	21 (50)[d]
A-7	23 (9)	42 (13)	25 (23)	35 (11)	56 (24)
F/A-18	20 (0)	13 (4)	28 (0)	11 (0)	19 (0)
F-14	35 (0)	31 (4)	41 (8)	24 (0)	40 (4)
S-3/VR VQ	60 (3)	58 (24)	64 (33)	76 (36)	82 (33)
VC	78 (0)	57 (13)	65 (26)	87 (30)	91 (61)
SGRAD	22 (0)	21 (2)	37 (7)	3 (0)	11 (0)
Fleet avg.	3.05 (.05)	3.05 (.04)	2.97 (.05)	3.04 (.02)	211.10 (29.80)

Percentage of below average observations greater than 1
Standard Deviations from the mean appear in parentheses ( )
a) Data obtained through CNO (OP-59) survey.
b) The following abbreviations are utilized :
   A4INST = A4 advanced instrument grade
   A4WEPS = A4 advanced weapons grade
   A4CQGRD = A4 carrier qualification grade
   A4FLT = A4 advance flight grade
   COMPSCR = unadjusted training command composite score
   VC = fleet composite squadrons
   SGRAD = students reassigned as flight instructors
c) East coast FRS data only
d) 4 of 8 observations

the aviator safely qualifies in landing his aircraft on the carrier. All other training is for naught if this final phase is unsuccessful. Fortunately, most aviators are able to qualify at the ship when it really counts. An individual's training costs are lost with no gained benefit unless this gauntlet is passed.

This "make it or break it" nature of the carrier qualification phase creates a stressful and momentous event in most category 1 trainee experiences. It is the criterion of success or failure in Naval Aviation. Upon completion, the aviator is a fully qualified fleet asset. It is the development of the skills required to perform this feat and the consistent, timely production of qualified aviators that determines the ultimate criteria of excellence in training by FRS units.

In the regression models presented, the dependent variable will be continuous and positive in all cases.

C. INDEPENDENT VARIABLE SELECTION

A total of 11 independent variables were investigated to determine their correlation with the ultimate success or failure observed in the carrier qualification grade at the FRS. These variables were selected on the basis of their suspected relevance to the skill acquisition required for carrier landing proficiency. Inputs from senior landing signal officers, instructors, and previous studies were used to help generate the variable list. Additionally,

constraints on information available due to data shortfalls and the structure of the original request also weighed in the variable selection process.

Table 7 shows the list of variables investigated for correlation with carrier qualification performance. These variables cross the entire spectrum of the aviation training syllabus from accession and flight aptitude testing scores, to the ultimate FRS carrier qualification experience.

D. SELECTION JUSTIFICATIONS

1. FRS Weapons Phase Grades

FRS weapons phase grades were selected as a potential explanatory variable because of their significance noted in previous research by three NMRL physiologists, Bale, Rikus and Ambler [Ref. 7]. Shannon and Waag also noted the positive correlation of tactics and weapons grades with ultimate carrier qualification scores [Ref. 8].

It is generally felt that the complexity of cockpit task management during weapons delivery evolutions demands great concentration, as well as multidimensional instrument and spatial orientation skills, that are also required in the carrier landing environment.

I hypothesized that the correlation between weapons phase scores and carrier qualification scores would be statistically significant and positive.

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TABLE 7

LISTING OF INDEPENDENT VARIABLES
BY IDENTIFICATION CODE AND TYPE

Variable Name	Code	Type
FRS Weapons Phase Grade	Frsweps	Continuous
FRS Instrument Phase Grade	Frsinst	Continuous
Aviation Qualification Test Score	AQT	Continuous
Flight Aptitude Rating	FAR	Continuous
Previous Fleet Aviation Tour	Expert	Dichotomous
Basic Flight Grade	T34flt	Continuous
Advanced Jet Trng Phase CQ Grade	A4cqgrd	Continuous
Advanced Jet Trng Weapons Phase Grade	A4weps	Continuous
Advanced Jet Trng Instrument Grade	A4inst	Continuous
Intermediate Jet Instrument Grade	T2inst	Continuous
Tracom Composite Score	Compscr	Continuous

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2. FRS Instrument Grades

FRS instrument grades represent advanced instrument flight grades that Hoffman demonstrated to be positively and significantly correlated with carrier qualification grades in his study [Ref. 6].

It is generally reported by senior landing signal officers that both the day-visual and night carrier landing approaches require signifi ant instrument proficiency and skills to place the aircraft in an acceptable position to transition "to the ball" on final approach and landing.

I hypothesized that advanced level and FRS instrument flight grades would be significantly and positively correlated with carrier landing qualification grades.

3. Aviation Qualification Test (AQT)

The Aviation Qualification Test (AQT) is a multi-faceted skill test measuring general intelligence. It is used to determine the educational level and aptitude of aviation candidate applicants. As a screening tool it identifies those individuals that are most suited for complex aviation ground training. It has historically been used to predict the applicant's potential success in academic training environments.

Many educational and industrial scientists believe that an individual's ability to rapidly assimilate new ideas

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and information can be estimated through standardized testing. [Ref. 9]

The AQT score was hypothesized to have a negative relationship to ultimate carrier qualification scores. Two researchers, Peterson and Lane, found this academic relationship in their study, The Relationship of College Major to Success in Naval Aviation Training [Ref. 10].

I hypothesized that beyond a functionally-required level of ability, academic skills would not necessarily enhance predicting carrier landing performance.

4. Flight Aptitude Rating (FAR)

Flight aptitude rating (FAR) scores are the second half of the AQT battery that is administered to all aviation candidate applicants. This test measures mechanical, spatial, and flight performance characteristics. It is used as a screening device for determining potentially promising flight candidates.

It was speculated that the FAR rating would be positively correlated to ultimate carrier qualification grades.

5. "Expert"

"Expert" was the term assigned to any category 1 strike aviator who had previous flying experience as a fleet instructor, naval flight officer, or pilot in another air warfare specialty. Previous studies have indicated a

positive relationship between experience levels and carrier qualification scores [Ref. 8].

I hypothesized that experience would be correlated positively with carrier qualification grades.

6. **T34 Flight Grades**

T34 flight grades were hypothesized to be positively and significantly correlated with carrier qualification grades. Recently, increased emphasis has been placed on raising the minimum basic composite score for entrance qualification into intermediate and advanced jet training. Regression model three incorporated this minimum basic flight grade criterion to select for below-minimum individuals and track their carrier qualification scores.

7. **A4 Carrier Qualification Grades**

A4 carrier qualification grades were selected as a predictor because the skills required closely duplicate those in FRS carrier qualification.

Most landing signal officers reported that individuals who experienced difficulty during the A4 carrier landing phase also had difficulties in FRS carrier qualification.

The A4 carrier qualification grades were hypothesized to be positively correlated with FRS carrier qualification grades.

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8.   <u>A4 Weapons Grades</u>

A4 weapons grades were selected for the same reasons as were A4 carrier qualification grades. They were hypothesized to be positively and significantly correlated with carrier qualification grades.

9.   <u>A4 Instrument Grades</u>

A4 instrument grades, like their counterpart in FRS units, were thought to reinforce the skills necessary to set up a day or night landing at the ship. Like the FRS grade, they were hypothesized to be positively and significantly correlated with fleet carrier qualification grades.

10.   <u>T2 Instrument Grades</u>

T2 instrument grades, unlike their A4 counterparts, were felt to be insignificant and possibly negatively related to carrier qualification grades. These grades accumulated very early in jet training, during initial jet turbine flight experiences. They were not hypothesized to be significant because of time and underlying flight experience differences from FRS carrier qualification.

11.   <u>A4 Downs</u>

A4 downs were selected as a predictor because it was hypothesized that the more difficulties a student encountered at the advanced jet training stage, the more likely he would encounter problems at the FRS.

As in previous examples, landing signal officers indicated that problem students in the FRS tended to have a history of landing phase downs.

Downs were felt to be negatively and significantly correlated to FRS carrier qualification performance. This variable was constructed in a dichotomous format. Zero was equivalent to 0-1 down, and 1 equaled multiple downs.

12. <u>Compscore</u>

Compscore was used because it was felt that the higher an individual's composite score upon graduating from training command, the more readily he absorbed information and handled new learning situations. It was therefore hypothesized that the correlation between compscore and carrier qualification would be positive and significant.

E. MODELLING

The quantitative analysis was performed using the standard statistical package (SPSSx) available at the Naval Postgraduate School.

All regression equations developed follow the classical multiple linear regression model:

$$Y_1 = B_0 + B_1 X_{11} + B_2 X_{21}, \ldots + B_k X_{k1} + E_1$$

Where:

B_0 = Regression Constant

$B_1 \ldots B_k$ = Predictor Variables

E_1 = Standard Error Term of the Regression

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TABLE 8

INDEPENDENT VARIABLES BY HYPOTHESIZED RELATIONSHIP AND
STATISTICAL SIGNIFICANCE WITH FRS CARRIER
QUALIFICATION PERFORMANCE

INDEPENDENT VARIABLE (Code)	RELATIONSHIP	SIGNIFICANT
Frsweps	+	yes
Frsinst	+	yes
AQT	−	no
FAR	+	no
Expert	+	no
T34flt	+	yes
A4cqgrd	+	yes
A4weps	+	yes
A4inst	+	yes
T2inst	−	no
Compscr	+	no

TABLE 9

REGRESSION MODEL ONE: A COMPOSITE OF
TRAINING COMMAND AND FRS DATA POINTS

MODEL FORM :

$$Y_i = 2.36 +.942X_1 -.733X_2 +.148X_3 -.057X_4 -.514X_5 + 1.22X_6$$
$$- 1.07X_7 +.411X_8 -.001X_9 +.051X_{10} +.001X_{11}$$

$R^2_{adj} = .93$

Std. Error = .149

Where: X_1 = FRS Weapons Phase Grade

X_2 = FRS Instrument Phase Grade

X_3 = Previous Experience Tour

X_4 = Aviation Qualification Test Score

X_5 = A4 Carrier Qualification Grade

X_6 = T34 Flight Phase Grade

X_7 = T2 Instrument Phase Grade

X_8 = A4 Instrument Score

X_9 = Composite Score

X_{10} = A4 Weapons Phase Score

X_{11} = Flight Aptitude Rating Score

TABLE 10

REGRESSION MODEL TWO: FRS DATA POINTS, SELECTING FOR
STUDENTS WHO DEMONSTRATED BELOW-AVERAGE FRS
CARRIER QUALIFICATION GRADES[a]

MODEL FORM :

$$Y_1 = -2.963 + .783X_1 - .086X_2 + 1.007X_3 - .005X_4$$

$R^2_{adj} = .52$

Std. Error = .279

Where[b] : X_1 = FRS weapons phase grade

X_2 = FRS downs

X_3 = instrument grades

X4 = expert

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a) Data generated through CNO (OP-59) survey.
b) Observations at FRS-level training only.

TABLE 11

REGRESSION MODEL THREE: TRAINING COMMAND DATA POINTS USED
TO PREDICT A4 CARRIER QUALIFICATION GRADES, SELECTING
FOR BELOW AVERAGE A4 CARRIER QUALIFICATION SCORES[a],
T34 FLIGHT GRADES LESS THAN 3.045[b],
FAR SCORES LESS THAN 7[c]

MODEL FORM :

$$Y_i = 3.54 - .016X_1 - 1.04X_2 + .641X_3 - .006X_4 + .140X_5 - .001X_6 + .081X_7$$

$R^2_{adj} = .44$

Std. Error = .014

Where: X_1 = A4 failed evolutions

X_2 = T2 flight grade

$X3$ = T34 flight grade

$X4$ = FAR

X_5 = A4 weapons grade

X_6 = Composite score

X_7 = T2 carrier qualification

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a) Data generated through CNO (OP-59) survey.
b) Current basic flight grade required to progress to
   intermediate jet training.
c) Current recruiting command minimum for acceptance into
   aviation training programs.
   FAR = flight aptitude rating test score
   Composite score = undergraduate level flight training
   composite score.

Table 12 provides a summary of the descriptive data compiled for the 157 matching cases used in regression model one. It can be compared to the overall sample averages and standard deviations based on the original 1,238 records.

TABLE 12

SAMPLE DESCRIPTIVE STATISTICS: MEANS AND STANDARD
DEVIATIONS FOR REGRESSION MODEL ONE[a]

Independent Variable (Code)	Mean	Standard Deviation
Frsweps	2.90	.61
Frsinst	3.06	.11
AQT	5.73	1.18
A4cqgrd	2.98	.05
T34flt	3.05	.02
T2inst	3.03	.02
Composite	215.06	22.73
A4inst	3.04	.02
A4weps	3.04	.03
FAR	8.0	1.23
Frscqgrd	2.74	.59

a) Data generated through CNO (OP-59) survey.

TABLE 13

INDEPENDENT VARIABLES BY OBSERVED RELATIONSHIP AND
STATISTICAL SIGNIFICANCE IN REGRESSION MODEL ONE[a]

INDEPENDENT VARIABLE (Code)	RELATIONSHIP	SIGNIFICANT
Frsweps	+	yes
Frsinst	−	yes
AQT	−	yes
FAR	+	no
Expert	+	no
T34flt	+	yes
A4cqgrd	−	no
A4weps	+	no
A4inst	+	no
T2inst	−	no
Compscr	−	no

a) Data generated through CNO (OP-59) survey and regression analysis.

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F.   OBSERVATIONS

The composite model developed in Chapter IV, Section E is further evaluated and analyzed in Chapter V. A standard linear regression statistical package (SPSSx) was used to generate correlation coefficient values and determine statistical significance.

Eleven variables were evaluated for correlation and significance to FRS carrier qualification performance. Three interesting observations were made. First, in the TRACOM-FRS regression model (Model One), FRS instrument scores demonstrated a negative relationship with FRS carrier qualification performance. In Model two (FRS data points only) this relationship is positive. Second, A4 carrier qualification grades demonstrated a negative and not statistically significant relationship with FRS carrier qualification performance. Third, Composite score demonstrated a negative and not statistically significant relationship with FRS carrier qualification performance.

A summary of descriptive statistics for the regression sample of 157 cases is provided for predictor variables in Table 13.

Analysis of these results is discussed in Chapter V.

V. CONCLUSIONS AND RECOMMENDATIONS

The conclusions of the study are divided into two parts. The first part deals with the qualitative portion of the analysis. The second part focuses on quantitative information.

Although no distinctly unique conclusions can be drawn from the qualitative analysis, eight meaningful points are stressed. Problems were encountered with the sample data collection and analysis conducted in the quantitative portion of the study. However, several inferences can be made from the analysis that substantiate and reinforce the results of previous research.

The quantitative problems and recommendations for further research are discussed in detail in Sections B and C of this chapter.

A. QUALITATIVE CONCLUSIONS

Peters and Waterman found that the excellent and outstanding companies in the United States exhibited 7 organizational/behavioral characteristics. These were:

1. bias for action
2. the ability to manage ambiguity and paradox
3. autonomy and enterprise
4. productivity through people

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5. hands-on value-driven experience

6. stick-to-it attitude

7. simple form/lean staff.

LT. Homer J. Coffman, USN and Capt. Hugh A. Ford, USAF in their Master's Theses determined that similar characteristics existed in the organizations they studied.

In the outstanding FRS units I visited, the following eight characteristics were observed :

1. top-down excellent leadership

2. action bias

3. realistic training opportunities

4. autonomy and entrepreneurship

5. hands-on experience

6. coaching instructors

7. electric enthusiasm

8. motivated, talented students.

I found every organization unique and functionally capable of performing its mission. The organizations that stood above the rest lacked none of the essential excellence criteria.

Each FRS, because of the differences in air-warfare specialties, demonstrated slightly unique approaches to handling training requirements and students. Each community demonstrated a special personality that seems related to the air-warfare specialty being imparted to the student.

Regardless of personality or warfare specialty, the excellent organizations consistently exhibited all of the 8 excellence criteria.

The stage was set at the top level of management, the CO, and carried throughout the command. The orientation of the unit towards its staff, instructors, and students was apparent from the moment I arrived, and was reinforced until I departed. The excellent FRS sought to make things happen, to resolve its problems, and tackled difficult issues in a straightforward manner. The constant focus of the outstanding FRS's was a commitment to excellent training, maintenance of high standards, and meeting all requirements in a consistent and timely manner.

The increasing budgetary constraints associated with reductions in training flight hours were often the primary concern in many of the FRS units. The focus, however, was on "how to make the pilots" with the assets available, not "how to get more" to make better pilots. This reflected autonomy and the stick-to-it attitude required of the excellent FRS in today's economic climate.

The excellent FRS made training opportunities realistic and demanding. It required high performance from students and instructors alike. Autonomy and entrepreneurship were evidenced especially in the training experiences of the excellent FRS. An outstanding training officer was one of the key ingredients of the successful FRS.

Hands-on knowledge and learning experience are the product of this dynamic training environment. Although the benefits of flight and weapons simulators were apparent, they never could replace the value or learning experience provided by the hands-on environment and an outstanding instructor cadre. It is one thing to fly instrument approaches or act out an engagement in the training simulator; it is quite another to perform the same task under the physical and mental stresses of actual flight in the tactical aircraft.

The single most valuable asset of the excellent FRS was its instructor cadre and their ability to enhance student acquisition of flying skills. The "coaching staff" of the FRS somehow managed to take the good, average, and weak students and step them up to the task and responsibility at hand. The excellent instructors managed the diverse abilities and personalities of their students to make each one "get better" and become an achiever.

Every FRS Commanding Officer placed "up-and-ready" aircraft on an importance level equal to that of his instructor cadre. One without the other made for an unworkable situation.

This instructing environment bred the electric enthusiasm that seems to be essential for excellence. It's hard to be good, but even more difficult to be excellent day in and day out. The "coaching staff" seemed to make the

difference. They found ways to keep the intensity level high in spite of detachments, long hours, and heavy workloads.

No single aviation community had a corner on the talent market. There are specific detailing policies that direct assignment of more talented students to some FRS units. Everyone received some lean material. Some FRS units, because of the configuration of the aircraft, are able to handle the lean better than others. Significant training problems occurred when marginal students were assigned to single pilot strike aircraft. Even the excellent FRS had difficulties in bringing this student up to speed. Within limitations, the excellent FRS is able to "make aviators" out of the greatest majority of students. Obviously, the more talented students are easier and cheaper to train. The excellent FRS managed to make most of its "black sheep" meet the standard.

To summarize, the excellent FRS is much like its counterpart in the civilian world. If one imagines that the development of naval aviators is similar to a single product manufacturing process, the connection between these findings and those of Peters and Waterman [Ref.1] should be clear.

Apparently, there is a definite recipe for excellence. Aggressiveness and action are rewarded. The ability to manage ambiguity and uncertainty are prerequisite. Autonomy and enterprise are extremely beneficial and essential to

management and the organization. Productivity is achieved through people, not the process. Hands-on value-driven experience is like cash in the bank for the production process. The stick-to-it attitude is required to make it through both the hard times and the good. Those without goals and resolve fail just as frequently during easy as during hard times. Simple management form and lean staff facilitate communication, information transfer, coordination, and control of the production process.

B. QUANTITATIVE CONCLUSIONS

If one envisions the FRS as a single product manufacturing facility, it follows that the final product is a composite of material and managerial inputs. It is difficult to separate the effects that management activity has on the final product from the initial forging and finishing process of the raw material. What can be measured is the quality of the aviator produced, based upon the semi-finished alloy received from TRACOM units. Much like the steel ingot that is rolled into a sheet configuration, the ultimate potential use of the product is determined by the purity of the alloy and the semi-finished characteristics of the rolled sheet metal. Obviously, high stress and performance applications of the product require a great deal of alloy specification and close finishing tolerances. Likewise, the ultimate potential utilization of the TRACOM naval aviator is conditioned by the tolerances under which

he was machined. It is with respect to the semi-finishing process and its relationship to FRS carrier qualification success that the quantitative portion of this research has been directed.

Eleven variables were explored to determine their relationship with ultimate FRS carrier qualification success. These independent variables were drawn from both TRACOM and FRS spectrums. A summary of their descriptions, hypothesized relationships, and statistical significance on carrier qualification in the FRS can be found in Tables 7 and 8. The observed coefficients, relationships, and statistical significance are presented in Tables 9, 10, and 11.

When conducting the regression analysis on both TRACOM and FRS data points, several interesting results were found.

Four significant variables emerged in the composite model. They were AQT scores, FRS instrument grades, T34 flight grades, and FRS weapons phase grades. These variables are discussed below along with other major findings from the research.

1. AQT Scores (Aviation Qualification Test)

The unexpected emergence of AQT scores as statistically significant and negatively correlated to ultimate carrier qualification scores at first appeared inconsistent. However, previous research conducted by Peterson and Lane at the Naval Aerospace Medical Institute

indicated that AQT scores were negatively correlated with aviation training success for persons who had majored in liberal arts in college [Ref 10]. Consistent with this, the largest portion of aviation accessions have entered military service through the AOCS and ROTC programs. It is suspected that many people in the sample may have this educational background. This could account for the statistical significance of the AQT score and the negative correlation with FRS carrier qualification grades.

    2. FRS Instrument Grades

        The negative and statistically significant correlation between FRS instrument grades and FRS carrier qualification scores was not anticipated. When examining only FRS data points, model two demonstrated that FRS instrument grades were both positively correlated and statistically significant with FRS carrier qualification grades. This is consistent with the same type of study conducted by Hoffman in 1973 dealing with FRS aviators and the F-4 fighter aircraft [Ref 6]. It is suspected that there is an overall positive relationship between instrument scores in the advanced jet portion of TRACOM, FRS flight phases, and FRS carrier qualification grades. Advanced jet training (A-4 instrument grades) were found to be positively correlated and slightly below statistically significant levels for predicting FRS carrier qualification grades.

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It is probable that by conducting factor analysis--and combining T2 intermediate instrument, A4 advanced jet instrument, and FRS instrument grades into a single independent variable--the combined variable would be both statistically significant and positively correlated with FRS carrier qualification grades. Currently, both FRS instrument and A4 instrument grades are positively correlated with FRS carrier qualification grades when examined individually.

3. T34 Flight Grades

T34 flight grades proved to be both statistically significant and positively correlated with ultimate FRS carrier qualification grades. Establishment of 3.045 as a minimum T34 flight grade for entering the strike pipeline training syllabus can be justified on statistical grounds. It should result in better FRS carrier qualification grades and is consistent with the results of this research.

4. FRS Weapons Phase Grades

Research conducted by Ambler, Bale and Rikus at NMRL found combat-related flight skills were positively correlated and statistically significant in predicting carrier landing qualification success. In this study, FRS weapons phase grades were found to be positively correlated and statistically significant in predicting FRS carrier qualification grades.

The FRS weapons phase grade in the strike aviation syllabus was the single most important factor in predicting FRS carrier qualification grades.

This statistical relationship matched nicely with the empirical observations of many instructors and FRS commanding officers. They felt that, since the weapons and tactics phase of their syllabus required incorporating all the tactical flying skills learned to this point, it should prove to be relevant in predicting FRS carrier qualification success.

5. Composite Score

A conclusion of the regression analysis was that the TRACOM composite score was not statistically significant and negatively correlated with FRS carrier qualification grades.

Using composite scores as a single predictor of FRS carrier qualification success is not statistically sound.

Interpreting the descriptive data found in Tables 5 and 6, it is noted that the aircraft platforms that currently are experiencing the greatest attrition rates (A-6,A-7,F-14) also received the largest percentages of aviators below one standard deviation from the mean in many of the performance areas measured.

It is suspected that, although the composite score was not directly related to ultimate carrier qualification grades, it is significantly related to the student aviator's ability to absorb the vast quantity of material and

techniques he is exposed to in the FRS. It is also probable that those individuals with higher composite scores are better able to differentiate and manage cockpit tasks in high-performance, high-g-load stressful aviation environments. It is well-documented that complex weapons systems demand "smart" and capable operators [Ref 11]. Additionally, the researcher's conclusion is that, as the student aviator's composite score goes below the mean, and ultimately the standard deviation break point, his ability to assimilate required technological and skill information decreases to the point that he is inundated by the demands of the training environment and is never able to get on the learning curve. The result is that his chances of success are slim in a time-compressed and constrained environment. It may prove cost-effective to create a detailing policy that places this individual in an environment where he is competitive and has the greatest chance of success, rather than end up with the sunk cost of his attrition or an aviation mishap.

For this limited sample (157) the results were encouraging. Ninety-three percent of the variation in FRS carrier qualification grades was accounted for in the 11 variables. The standard error associated with the regression was small (.149) and it is felt that the results can be duplicated on a larger composite sample of TRACOM and FRS records.

In model two only the FRS data points were examined. The sample analyzed was controlled for below-average carrier qualification grades, but at least average overall FRS performance. The results in Table 10 are consistent with all hypotheses on correlation and statistical significance. FRS weapons, downs, and instrument grades all proved to be statistically significant and positively correlated with FRS carrier qualification grades.

6. Sergrad Effect (graduated student aviator reassigned to TRACOM as an instructor)

A most interesting result was the slightly negative relationship found between prior fleet experience, as in the case of Sergrads, and FRS carrier qualification scores. This finding was consistent with interviews conducted with AirPac landing signal officers and FRS commanding officers. Although Sergrads generally had an easier time getting through the flight and academic syllabus in the FRS, they had no edge in FRS carrier qualification.

Model two accounted for 52 percent of the variation in FRS carrier landing grades by using the four data points listed in Table 10. The standard error of the regression (.279) was somewhat larger than the standard error for model one, but within reasonable tolerances for using four variables.

Model three represents the application of this same regression procedure on the TRACOM advanced jet carrier qualification phase.

It is important to note that the advanced jet carrier qualification grades (A4cqgrd) exhibited the least amount of variance in all carrier landing scores.

Table 11 summarizes the results of the regression. Three control points were chosen. First, only below-average carrier qualification scores were selected. Second, an application of the new CNATRA strike pipeline assignment criteria was applied, by examining only those aviators with less than 3.045 T34 flight grades. Finally, a FAR cut-off score was applied to isolate those aviators who might have been weak in initial flight aptitude and to determine if they experienced difficulty.

Thirty-three student aviators met this selection criteria. T2 flight, A4 downs, and T34 flight grades were found significant in accounting for variations in carrier landing grades. A4 weapons grades were slightly below the significant level.

The model accounted for 44 percent of the variation in carrier landing scores when adjusted for the small sample size, and 56 percent if unadjusted. The standard error of the regression (.014) was the smallest experienced.

Continuing research with TRACOM data points may prove valuable in determining phase performance cut-off criteria for the strike aviation pipeline.

C. POLICY IMPLICATIONS

Because of the limited numbers of matching TRACOM and FRS records (157), this research project is unable to conclude that the phase grades identified as positively correlated with ultimate FRS carrier qualification scores are valid enough to generate detailing policy decisions for the Strike Aviation community.

Certain empirical observations were verified statistically as being correct and significant. First, focusing upon the composite score as a single indicator of potential for FRS carrier qualification cannot be justified on the basis of this research. Indeed, there appears to be concern for those falling below the sample mean of 215, and specifically for those that are one standard deviation or greater below the mean of each aircraft community. These students stand a high probability of encountering training difficulties in the future. This is particularly true in demanding airframes and flight regimens. The composite score, however, was neither positively related nor statistically significant in accounting for carrier qualification variance at the FRS level. It appears to indicate how quickly the student can assimilate, retain, and recall information that is thrust upon him in increasing quantities and complexity. Additionally, the composite score seems to indicate those student aviators who will best handle the stress of the FRS environment.

Second, T34 flight grades, A4 instrument, A4 weapons, and FRS weapons grades are positively correlated with FRS carrier qualification scores, and account for the greatest part of qualification score variance.

If directed detailing is the ultimate goal of this and future studies, the potential exists to combine these factors into an algorithm for detailing students.

Additionally, potential exists for the prediction of carrier qualification grades and the student's ultimate success or failure in this portion of the training syllabus.

D. ADDITIONAL RESEARCH

It is recommended that a second data sample be collected from both TRACOM and the FRS squadrons. Adequate overlap in time intervals should be allowed to provide for maximum record matching. Emphasis on the submission of accurate and complete social security numbers with all student records should be stressed. In addition, conversions of ordinal data to cardinal data at the FRS and TRACOM level will create a much more diverse and complete sample for research purposes.

If these weaknesses can be corrected, future research may be able to improve or refine the directed detailing policy and create a more cost-effective method of assigning aviators.

Though far from complete, current research takes a step in the right direction to assure that Naval Aviation shall

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continue to maintain its performance image and standards into the future.

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